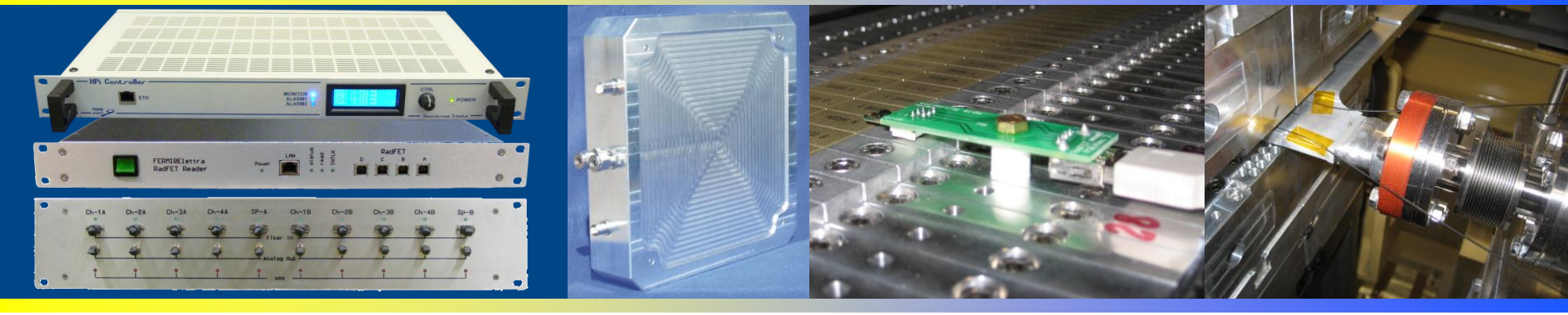
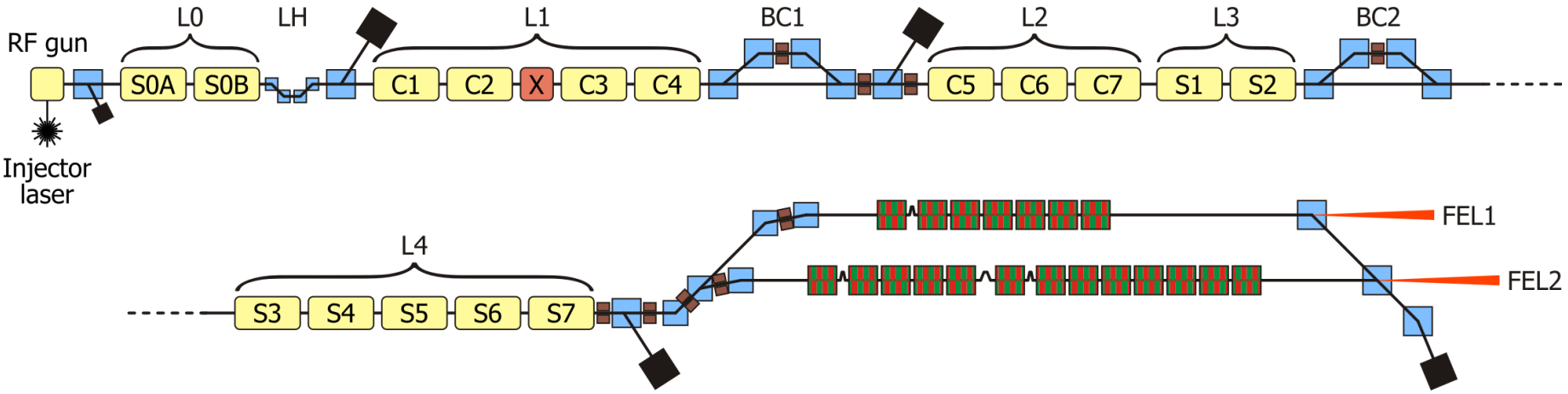
Instrumentation for Machine Protection at FERMI@Elettra



L. Fröhlich, A. I. Bogani, K. Casarin, G. Cautero, G. Gaio,
D. Giuressi, A. Gubertini, R. H. Menk, E. Quai, G. Scalamera,
A. Vascotto (Sincrotrone Trieste, Basovizza, Italy)
L. Catani (INFN, Rome, Italy), D. Di Giovenale

FERMI@Elettra

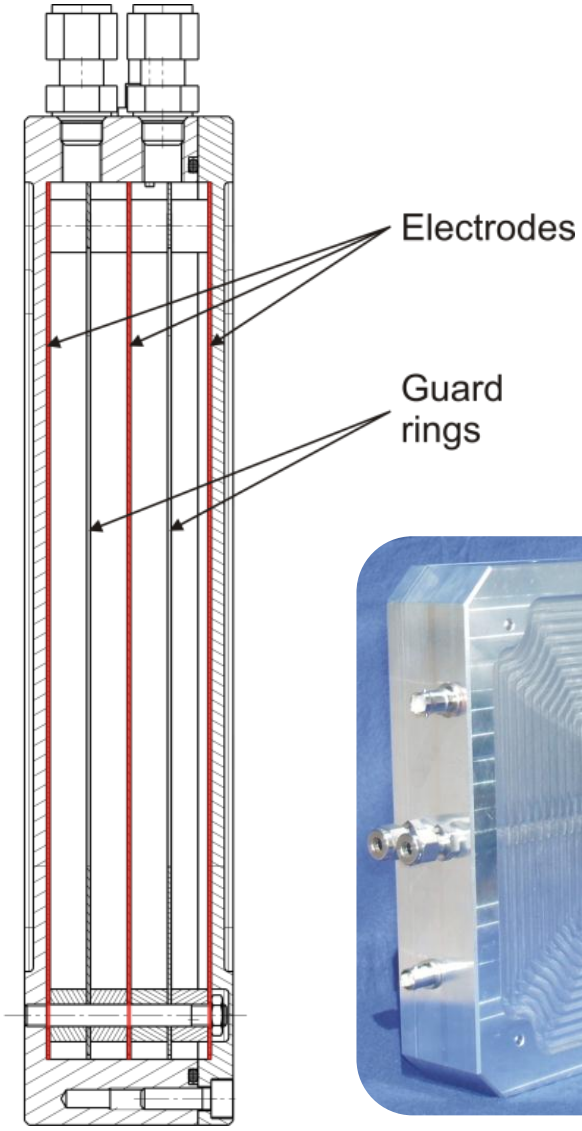


	Energy	Bunch Charge	Repetition Rate	Beam Power
Typical	1.2 GeV	350 pC	10 Hz	4.2 W
Design	1.5 GeV	1 nC	50 Hz	75 W

Ionization Chambers

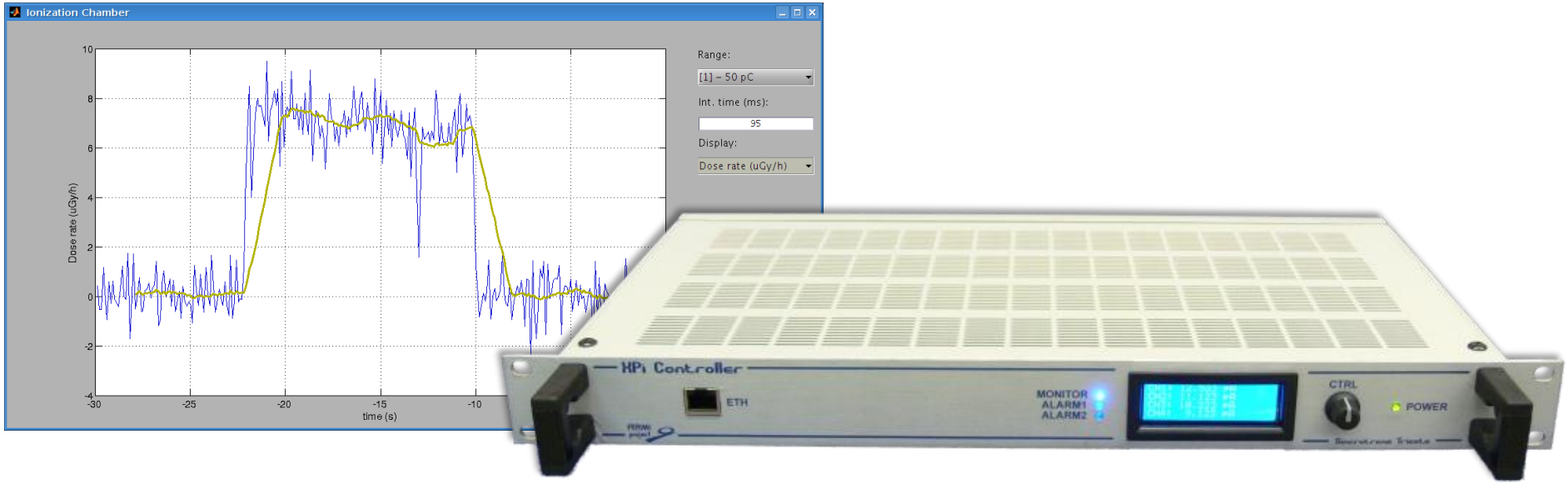
Ionization Chambers

- 1 ionization chamber per undulator segment (19 total)
- Simple milled aluminum enclosure
- Electrodes: printed circuit boards
- Use in air (Fermi) or with gas flux
- Volume: 1.3 l
- Sensitivity (air): ~46 µC/Gy



Ionization Chamber Frontend

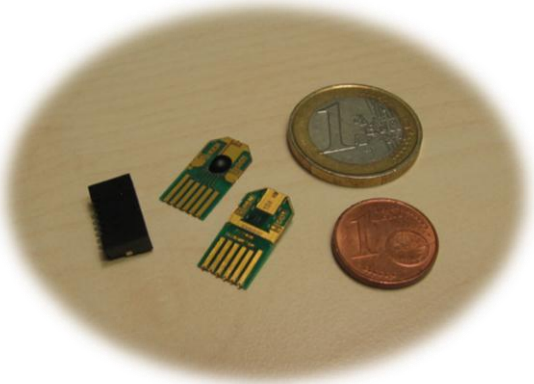
- Integrated readout and HV generation 0…1000 V
- Microprocessor controlled
- Ethernet interface
- Charge-integrating amplifier and 20-bit ADC
- Full charge range: 0…50 pC — 0…1.8 nC
- Integration time: 1 ms – 1 s
- 2 programmable alarm outputs
- Noise floor (with Fermi chamber): <0.4 µGy/h (rms)

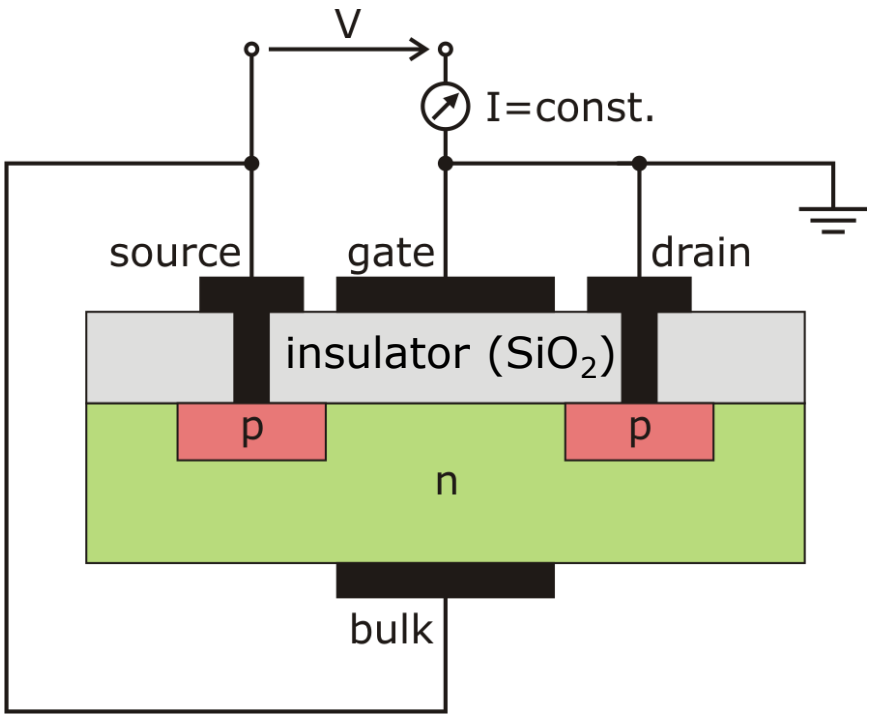


Online Solid-State Dosimetry

RADFET Dosimeters

- MOSFETs with 300 nm insulator layer
- Readout:
  Track voltage for constant current
  (490 µA) between source and drain

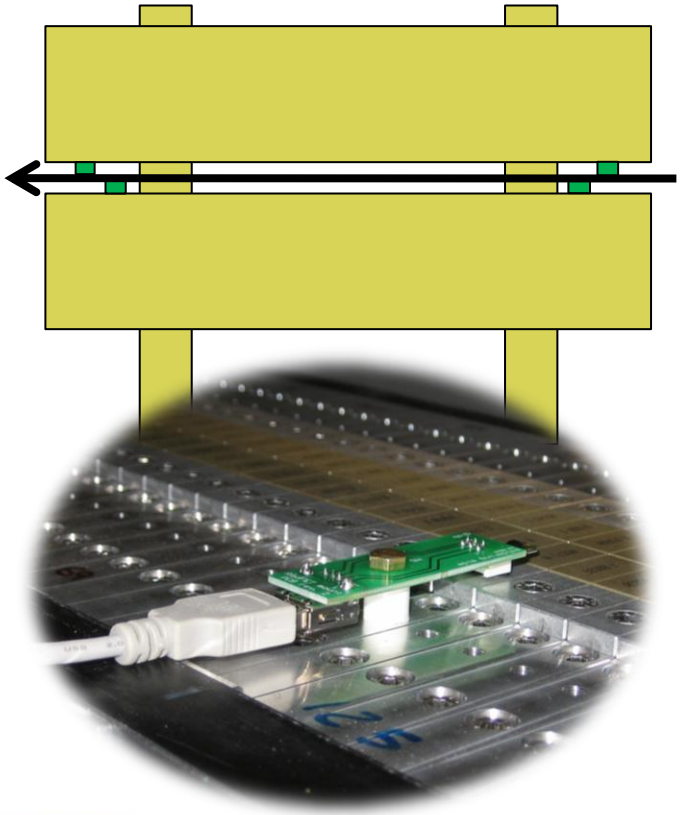


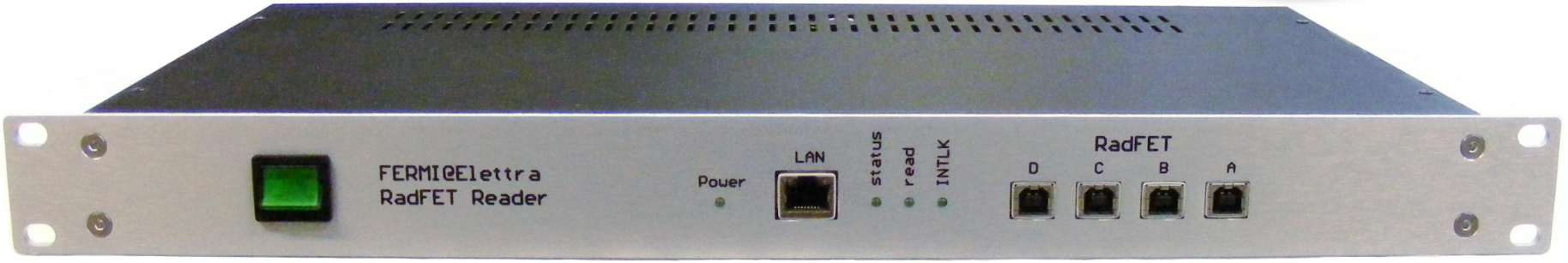


unpublished data

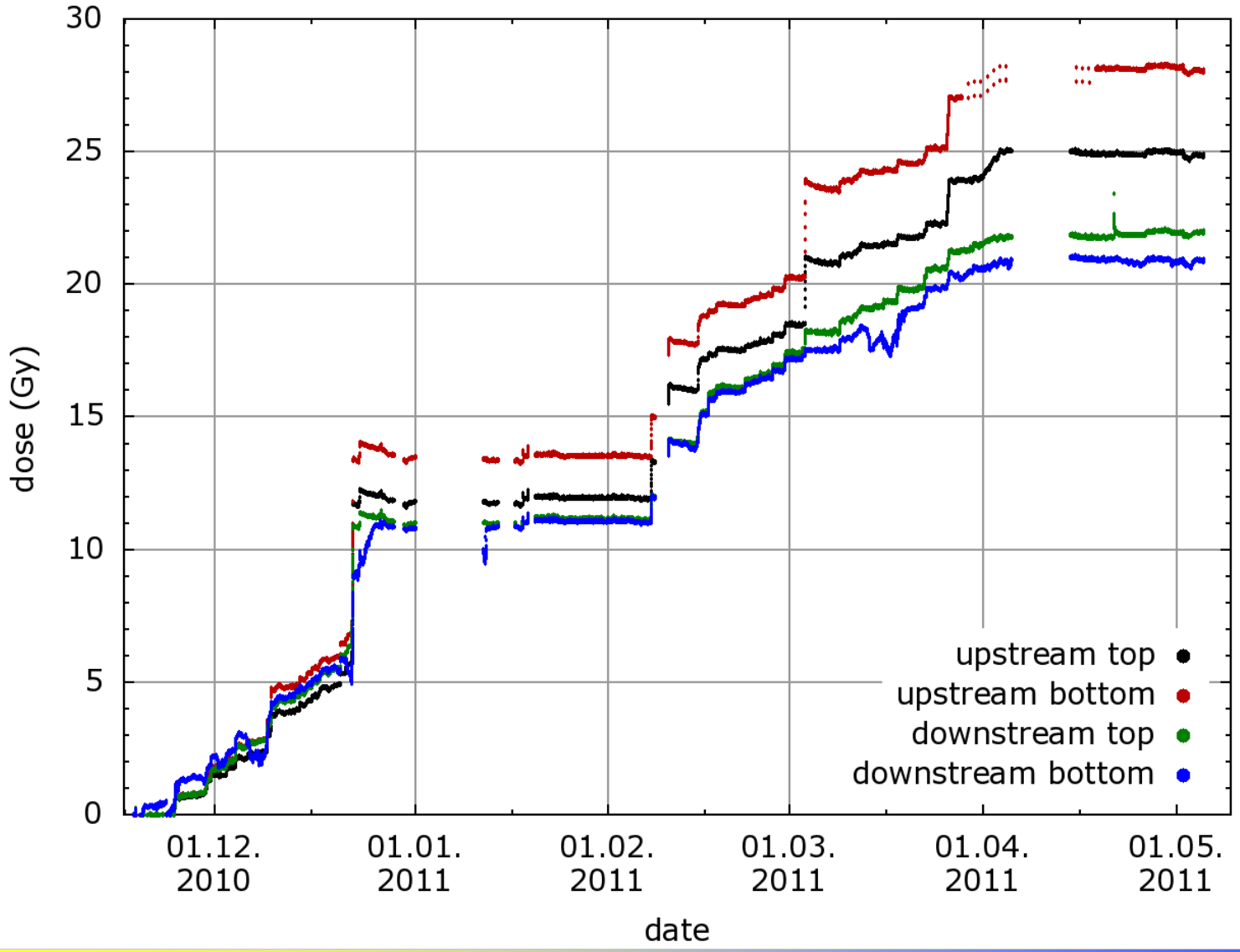
RADFET Reader

- Microprocessor controlled
- Ethernet connection
- 4 RADFET channels (up to 25 V)
- Programmable interlock output
- Readout period down to 10 s
- Uses standard USB cables





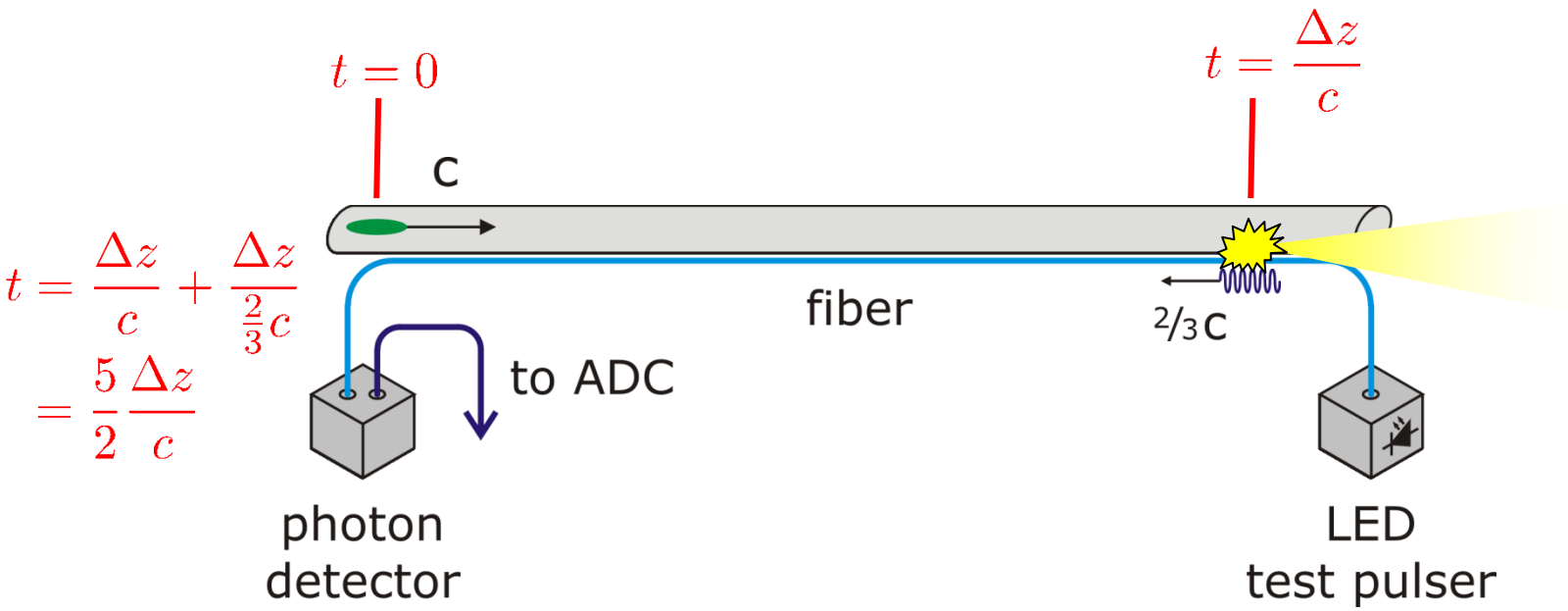
Dose History Undulator 1



Cherenkov Fiber Beam Loss Position Monitor

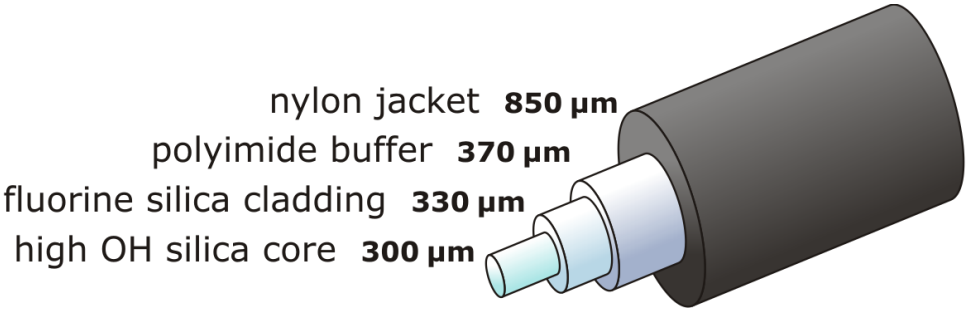
Lars Fröhlich, Sincrotrone Trieste

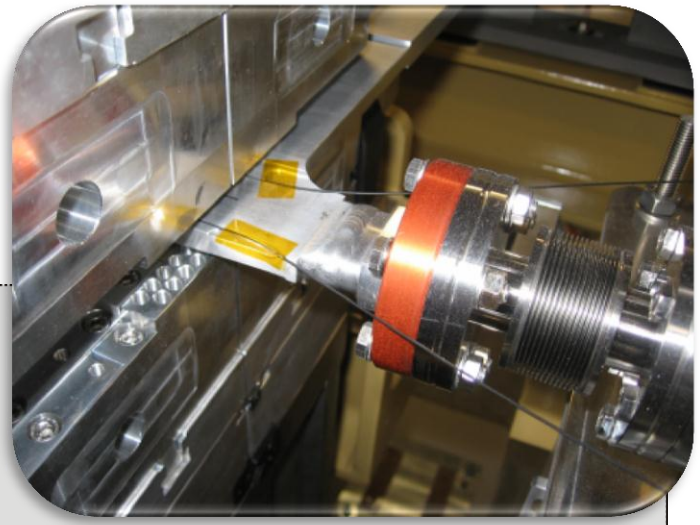
Beam Loss Position Monitor

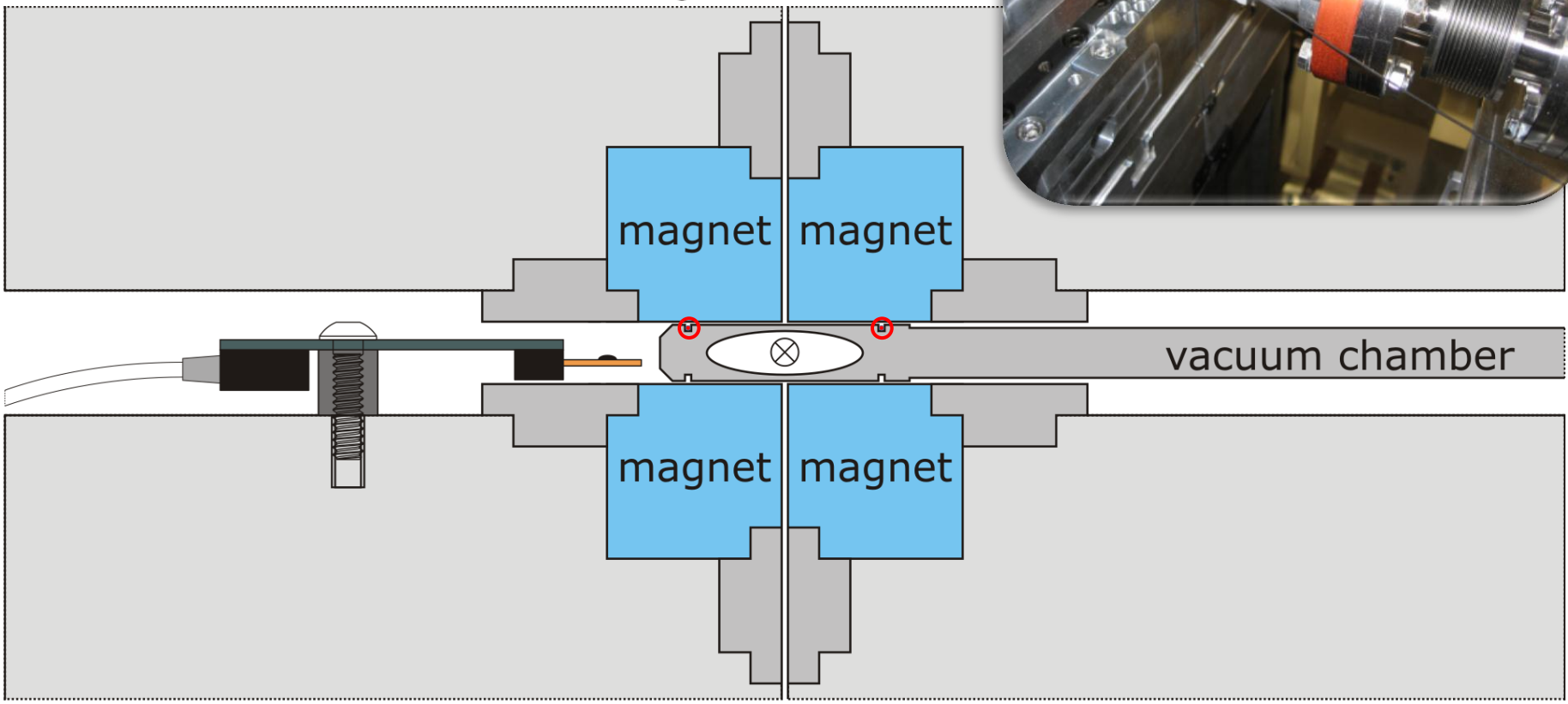


- 100 m long fibers
- 250 MS/s ADC → longitudinal resolution ~50 cm

Undulator Cross Section

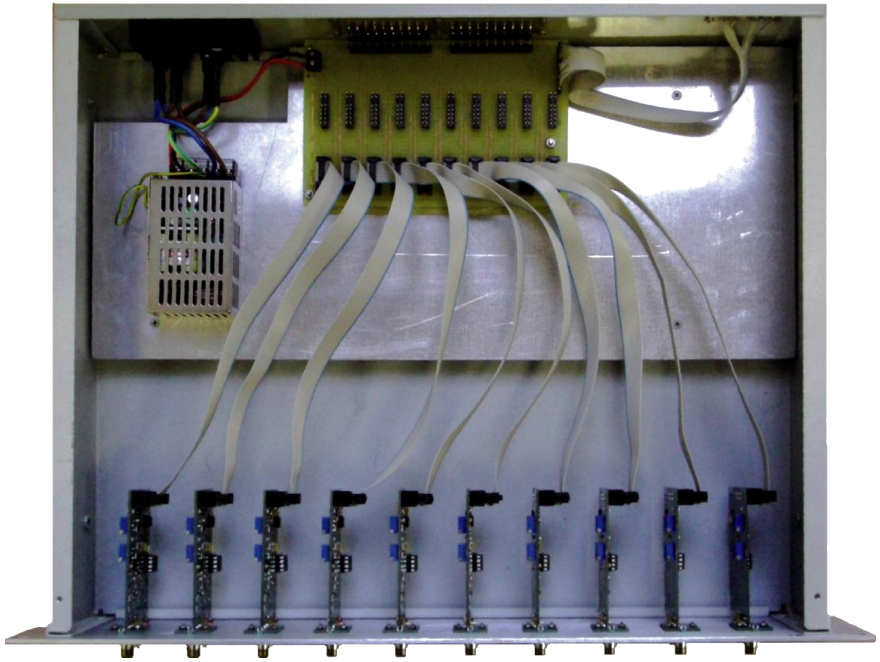




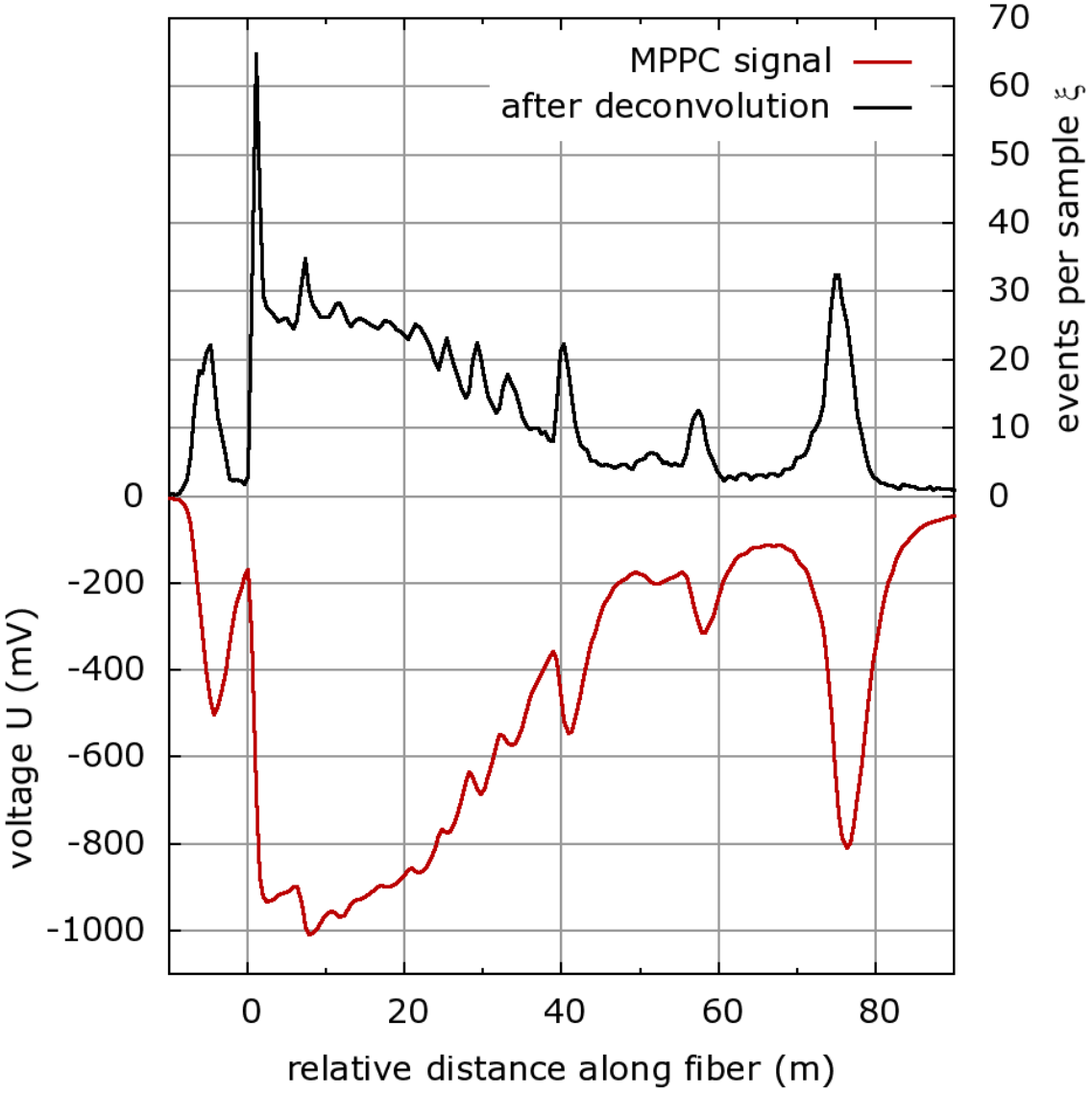


Beam Loss Position Monitor

- Modular frontend electronics
- Multi-pixel photon counters (MPPCs): 400 avalanche photodiodes in parallel at 70 V reverse bias
- Temperature-compensated gain
- Configurable alarm thresholds



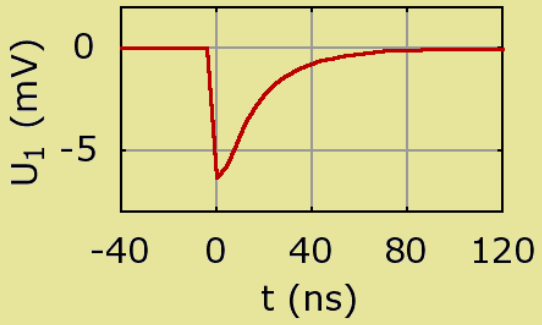
Signal Processing



number of photodiode breakdowns

deconvolution

$$\xi(t) = \mathcal{F}_\nu^{-1}\left[\frac{\mathcal{F}_t[U(t)]}{\mathcal{F}_t[U_1(t)]}\right]$$



MPPC output signal

Thanks for your interest.

Many thanks to:
- Mario Ferianis, Fabio Giacuzzo, Alessandro Carniel, and the instrumentation and controls groups of Sincrotrone Trieste
- Arne Miller (Risø High Dose Reference Laboratory, DK)
- Andrew Holmes-Siedle (REM Oxford Ltd., UK)